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APPLICATION FOR UNITED STATES LETTERS PATENT

INVENTOR: ANTONIO CHIGA

TITLE: FILTER FOR FLUIDS, ESPECIALLY  
FUELS

ATTORNEY: STEVEN P. SHURTZ  
Registration No. 31,424  
BRINKS HOFER GILSON & LIONE  
P.O. BOX 10395  
CHICAGO, ILLINOIS 60610  
(312) 321-4200

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## FILTER FOR FLUIDS, ESPECIALLY FUELS

### BACKGROUND OF THE INVENTION

5 The invention relates to a filter for fluids, especially fuels, having a body supporting a filter fabric and which serves to keep opposed sides of the filter body formed by the filter fabric spaced a distance from one another and having a pump connection neck positioned on the exterior of the filter body. The interior of the filter body has an inlet opening. The supporting body is completely enclosed by the filter fabric and has a connection to the exterior via the inlet opening and a pump connection neck. The filter has a first part containing the pump connection neck and at least one second part positioned in an angle with respect to the first part.

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20 A filter of this kind is shown in PCT Publication No. WO 00/03784. In this known filter, the first part and the second part together form the filter body, wherein the two parts are connected to one another by the means of a joint. The second part and the first part (together with the filter fabric) can be folded from a straight starting position into an angular position, and by the means of a locking device can be fixed in the angular position. Filters of this kind should have a construction as simple as possible. Fuel filters are intended to be mounted in the fuel tank of vehicles. The filter function here is performed by the filter fabric, wherein the supporting body is serving to keep the opposed sides of the filter body formed by the filter fabric at a distance from one another since otherwise both sides could partly stick together, whereby the filter area presented would be decreased. The above described filter makes it possible to have a largest possible filter area in a smallest possible space, wherein especially in connection with fuel filters the known filter can be positioned in an extremely small suction space such that a complete emptying of the fuel from the fuel container is possible. By the construction according to which the two parts are extending in an angle, especially in a right angle to each other, the filter demands an extremely small space in spite of a large filter area.

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Starting out from the known filter of the above defined kind, it is the task to be solved by the present invention to drastically simplify the design and construction of the filter while maintaining all advantages such that the production costs of the filter, too, can be drastically decreased.

## BRIEF SUMMARY OF THE INVENTION

This task is solved in a filter of the above defined kind basically by the features that the first part is formed by a tubular body which on its first end has the pump connection neck extending generally in a right angle with respect to the main axis of the tubular body and which, on its second end, is provided with an axially extending inlet opening. The second part of the filter is formed of a filter body comprised of a supporting body and the filter fabric. The filter body is fixedly connected in a predetermined angular position with respect to the tubular body.

In a first aspect the invention is a vehicle fuel filter for mounting to a fuel pump in a fuel tank comprising a tubular body having an axis, a first end and a second end opposite the first end; a pump connection neck positioned on the first end of the tubular body and having a filter outlet opening for mounting the filter on a fuel pump intake, the filter outlet opening having an axis at a substantially right angle to the axis of the tubular body; an inlet opening on the second end of the tubular body, the inlet opening extending axially in the direction of the axis of the tubular body; an envelope of filter fabric surrounding the inlet opening such that fuel entering into the envelope can pass into the tubular body through the inlet opening; and a supporting body fixedly connected to the tubular body at the second end and at a predetermined angle to the tubular body, at least a portion of the supporting body preventing the filter envelope from collapsing.

The preferred filter of the invention has a two-part construction formed from the first part as a simple tubular body, which is fixedly connected with the actual filter body (which forms the second part of the filter) in a chosen angular position corresponding to the demands of the use, instead of a comparatively complicated joint section. The simple tubular body enables an almost complete

emptying of the fuel tank because the filter also includes an intake opening opposite to the pump connection neck, with filter fabric fixed therein. With this additional intake opening, the suction distance of the filter is decreased to almost one quarter, whereby, for example, an engine in the starting phase can start-up more quickly. Further, this additional intake opening has the advantage that the fuel tank can be emptied down to the level of said intake opening.

In a preferred embodiment according to the invention, the intake opening has at least the cross-section of the pump connection neck. The flow from the intake opening to the pump is improved by this feature.

In spite of the fact that, according to the field of use, many deliberate shapes of the cross-section are possible, according to an embodiment of the invention it is further preferred that the tubular body has an rectangular cross-section. This has the advantage of a simple construction of the pump connection neck and of a flat filter area in the intake opening.

It is further preferred that the supporting body is injection molded onto the filter fabric forming one side of the filter body. This simplifies the production of the filter.

It is further preferred that the filter fabric forming the other side of the filter body be connected with the filter fabric forming the one side of the filter body by a weld forming part or all of the circumference of the filter body. This further simplifies the method of production.

An especially preferred embodiment of the invention uses a tubular body that has a reinforcement at the inlet opening. The reinforcement surrounds the inlet opening and forms an interior shoulder. The connection piece of the filter abuts the interior shoulder in such a way that the free cross-section for the flow in the inlet opening remains unchanged.

It is preferred that the connection piece be permanently fixed on the inlet opening of the tubular body by ultrasonic welding or the like.

To further simplify the production, the outer interior edge of the inlet opening preferably has an inlet bevel.

A further especially preferred embodiment of the invention includes a clamping device next to the pump connection neck on the exterior of the tubular body for mounting the filter on the suction side of a pump.

This clamping device preferably has a unitary lateral projection of the tubular body and is formed by a slot surrounded by a downwardly extending skirt, wherein the skirt has a slight conicity. The conicity preferably is about 3°.

This preferred embodiment of the clamping device has the advantage that the mounting of the filter on the suction side of a pump is substantially simplified compared with the prior art because the tubular body and projection are made of suitable artificial resin. The resilient properties of the conically designed skirt are sufficient to safely fix the filter on the pump connector on the suction side of the pump by simply sliding the slot over a plug or the like provided on the pump. In prior art constructions it was necessary to form a pocket into which a metal clip was inserted, which had to be secured against falling out by an additional step.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention is more fully described with reference to an exemplary embodiment shown in the drawings, in which:

Figure 1 is a partly schematically lateral view in cross-section of a preferred embodiment of the filter of the invention, taken along line I-I of Figure 3;

Figure 2 is a bottom view of the filter of Figure 1, wherein the filter fabric is shown in cross-section;

Figure 3 is a front view of the filter of Figure 1;

Figure 4 is a cross-sectional view taken along line IV-IV of Figure 5 of the clamping device of the filter of Figures 1 to 3 in an enlarged scale, and

Figure 5 is a top view of the area of the clamping device according to Figure 4, also in an enlarged scale.

## DETAILED DESCRIPTION OF THE DRAWINGS AND PREFERRED EMBODIMENT OF THE INVENTION

The filter 1 for fluids, especially fuels, shown in the drawings in all details is made of an artificial resin suitable for this purpose. Filter 1 comprises a supporting body 4, which supports a plastic filter fabric or mesh 6 to keep the opposed sides 8 and 10 of a filter body formed by the filter fabric 6 in a spaced apart relationship from each other to prevent filter 1 from collapsing during use.

On the exterior of the filter, a pump connection neck 14 of usual construction is provided which has an inlet opening 16 in the interior of the filter body 12, formed by the filter fabric 6 and the supporting body 4.

The supporting body 4 is completely enclosed in the filter fabric 6 and merely is connected with the exterior of filter 1 by the inlet opening 16 and the pump connection neck 14.

As shown, filter 1 is made of two parts 18 and 20 positioned, in the preferred embodiment, at a right angle to each other. The first part 18 includes the pump connection neck 14 and the second part 20 includes the supporting body 4.

In the preferred embodiment of the invention, the first part 18 is formed by a tubular body 22 monolithically formed with the pump connection neck 14. The tubular body 22 as shown in Figure 3 has a rectangular cross-section. The pump connection neck 14 is formed on the first end 24 of the tubular body 22, positioned at a generally right angle to the main axis of the tubular body 22. The tubular body 22 is provided on its second end 26 with the axially extending inlet opening 16. As further described below, the filter body 12 is fixed on the second end 26.

Further, the tubular body 22 is provided with an intake opening 28 directly opposite to the pump connection neck 14, which is covered by filter fabric 30. The intake opening 26 can have any desired shape. Preferably it has a circular shape to correspond to the cross-section of the pump connection neck 14. Preferably it has at least the same cross-section as the pump connection neck 14.

In the exemplary embodiment shown in the drawings, the filter body 12 is made of the supporting body 4 and the filter fabric 6. These combined form the

second part of the filter 1, which is fixedly connected with the tubular body 22 in the desired angular position with respect to the tubular body 22.

As further can be seen from Figures 1 to 3, during the production of the filter body 12 the supporting body 4 is injection molded onto the filter fabric 6, forming the left wall in the view according to Figure 1, i.e. the one side 10 of the filter body 12. The opposite wall, i.e. the other side 8 of the filter body 12, is formed by folding the filter fabric 6 and welding it at the edges by the weld 13 shown in Figure 3. In this preferred embodiment, only the filter fabric 6 forms the other side 8 of the filter body 12. The filter fabric 6 forms the opposite side 10 of the filter body 12 by the weld 13 running along the three side edges of the filter body 12.

As can be seen from the cross-sectional view according to Figure 1, the tubular body 22 is provided at the inlet opening 16 with a reinforcement 32 surrounding the inlet opening 16. Reinforcement 32 forms an interior shoulder 34. A connection piece 36 of the filter body 12, which is unitary with the supporting body 4 and which is also injection molded to the side 10 of the filter fabric 6 of the filter body 12, is abutting the interior shoulder 34. The dimensions in this connection are chosen such that the connection between the connection piece 36 and the tubular body 22 is such that the free cross-section of flow in the inlet opening 16 remains unchanged.

The connection piece 36 is preferably permanently fixed to the inlet opening 16 of the tubular body 22 by ultrasonic welding or equivalent means. The desired angular relation between the first part 18 and the second part 20 of filter 1 is predetermined for the corresponding design of the connection piece 36 during the production, according to the geometry of the planned use of filter 1.

To further simplify mounting, the outer interior edge 38 of the inlet opening 36 has an inlet bevel 40.

To mount the filter 1 by means of the pump connection neck 14 on the suction side of a fuel conveying means (not shown), an especially designed clamping device 42 is formed in an unitary lateral projection 44 of the tubular body 22. The clamping device 42 includes a slot 46 surrounded by a downwardly

extending skirt 48. The skirt 48 has a downwardly directed slight conicity, which in the exemplary embodiment is about 3°. If the slot 46 with the skirt 48 is pushed onto a plug provided on the fuel conveying means, the conicity of the skirt 48 provides an extremely safe, non-positive connection in a mostly simple way.

Since such filters in common practice form a composite construction with the fuel conveying means positioned in the interior of a fuel container of the vehicle (not shown), such a safe connection provides a substantial advantage.

All details and advantages of the invention, which can be seen from the specification, the claims and the drawings, including constructive details and positions in space, for themselves and in any deliberate combination could be important for the invention.

It should be appreciated that the apparatus of the present invention is capable of being incorporated in the form of a variety of embodiments, only one of which has been illustrated and described above. The invention may be embodied in other forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive, and the scope of the invention, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.